Title: **LIQUID CRYSTAL DISPLAYS**

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Cross Reference to Related Applications

[0001] This application claims priority of Taiwan Patent Application Serial No. 091124962 filed on October 25, 2002.

Field of Invention

[0002] The present invention relates to an LCD (Liquid Crystal Display) and its method of manufacture.

Background of the Invention

[0003] Compared with a CRT (cathode ray tube) display, the LCD has the advantages of less weight, smaller volume, and lower radiation. Hence, we can expect that the LCD will substitute the CRT display to be the most popular display.

[0004] Conventional LCDs include a liquid crystal panel and a back light device. The liquid crystal panel includes a top substrate, a bottom substrate and a liquid crystal layer formed between the top substrate and the bottom substrate. The top substrate has a CF (Color Filter). The bottom substrate has a TFT (thin film transistor). Beside, a top polarizer is disposed on the top substrate and a bottom polarizer is disposed between the bottom polarizer and the back light device.

[0005] A Black Matrix may be plated on a CF to increase contract and prevent mix of color and leakage of light. Hence, the LCD is better than the CRT display in resolution. However, if the resolution is promoted without the pitch of the pixels being narrowed, the aperture ratio of pixels will be reduced and the brightness of the LCD will decrease.

Hence, narrowing the Black Matrix or studying other methods to improve the brightness is an important issue.

Summary of the Invention

[0006] One aspect of the present invention is to provide an LCD with better aperture ratio and a method for manufacturing the LCD.

[0007] Another aspect of the present invention is to reduce the disconnection caused by a signal line.

[0008] Still another aspect of the present invention is to avoid the light leakage of the LCD.

[0009] The other aspect of the present invention is to reduce the capacity effect between a signal line and a pixel electrode.

[0010] In the present invention, a first gate line and a second gate are formed on a substrate. The first gate line intersects with and is insulated from the second gate line. After that, an insulation layer, a semiconductor layer, a data line, a passivation layer, a low dielectric constant layer and a pixel electrode are formed sequentially. The data line overlaps the first gate line. A dielectric constant layer is a low dielectric constant layer. The pixel electrode overlaps with a portion of the first gate line and a portion of the second gate line. The data line overlaps with a portion of the first gate line. The portion of the first gate line overlapped by the pixel electrode is different from the portion of the first gate line overlapped by the data line. Therefore, the capacity effect between the pixel electrode and the data line is avoided. In the second embodiment of the present invention, another kind of LCD is disclosed. The first gate line is replaced by a gate line including a pair of gate lines that are parallel to each other and separated by a gap.

[0011] The advantages and spirit of the present invention may be further comprehended through the following detailed description and drawings.

Brief Description of the Drawings

[0012] The present invention is illustrated by way of example and not limitation in the accompanying figures, in which like references indicate similar elements, and in which:

[0013] Fig. 1a is a schematic diagram of the first embodiment of the present invention;

[0014] Fig. 1b is a cross-sectional diagram along the line I-I' of Fig. 1a;

[0015] Fig. 1c is a cross-sectional diagram along the line II-II' of Fig. 1a;

[0016] Fig. 2a is a schematic diagram of the second embodiment of the present invention;

[0017] Fig. 2b is a cross-sectional diagram along the line III-III' in Fig. 2a;

[0018] Fig. 2c is a cross-sectional diagram along the line IV-IV' of Fig. 2a.

Detailed Description

[0019] Fig. 1a is a schematic diagram of the first embodiment of the present invention. The LCD of the present invention includes a plurality of first gate lines 11, a plurality of second gate lines 12, a plurality of data lines 19 and a plurality of pixel electrodes 13. Only one of the pixels is illustrated in Fig.1a. The first gate line 11 intersects with and is insulated from the second gate line 12. The data line 19 overlaps a portion of the first gate line 11. The pixel electrode 13 also overlaps a portion of the first gate line 11 and a portion of the second gate line 12. However, in the first gate line11, the overlapping portion of the data line 19 is different from the one of the pixel electrode 13.

[0020] Fig. 1b is a cross-sectional diagram along the line I-I' of Fig. 1a. On a substrate, such as a glass substrate, the first gate line 11, an insulation layer 15, a semiconductor layer 17, a data line 19, a passivation layer 21, a low dielectric constant layer 23 and a

pixel electrode 13 are formed sequentially. Obviously, the portion that the data line 19 overlaps the first gate line 11 is different from the portion that the pixel electrode 13 overlaps the first gate line 11.

[0021] Fig. 1c is a cross-sectional diagram along the line II-II' of Fig. 1a. In the present invention, the second gate line 12 and the insulation layer 15 are formed sequentially on the substrate 100. Thus, after the semiconductor layer 17 and the data line 19 are formed as illustrated in Fig. 1b, the passivation layer 21, the low dielectric constant layer 23 and the pixel electrode 13 are formed sequentially. As shown in Fig. 1c, the pixel electrode 13 overlaps a portion of the second gate line 12.

[0022] In the present invention, the material of the insulation layer 15 includes a Si_3N_4 layer depositing above the first gate line 11, the second gate line 12 and the substrate 100. The material of the semiconductor layer 17 includes an undoped Si amorphous layer and a doped Si amorphous layer. The material of passivation layer 21 includes Si_3N_4. The low dielectric constant layer 23 is a transparent material with low dielectric constant, such as the acrylic. The material of the pixel electrode 13 includes ITO (Indium Tin Oxide).

[0023] Fig. 2a is a schematic diagram of the second embodiment of the present invention. In the present invention, an LCD includes a plurality of gate line pairs 31, a plurality of gate lines 32, a plurality of data lines 39 and a plurality of pixel electrodes 33. Only one pixel is illustrated in Fig.2a. The gate line pair 31 intersects with and is insulated from the gate line pair 32. The gate line pair 31 includes a first gate line 311 and a second gate line 312. The first gate line 311 parallels the second gate line 312 with a gap 314 therebetween. The data line 39 overlaps a portion of the gate line 31 and the gap 314. Besides, the pixel electrode 33 also overlaps a portion of the gate line pairs 31. However, in the gate lines 31, the overlapping portion of the data line 39 is different from the same

of the pixel electrode 33. Likewise, the pixel electrode 33 also overlaps a portion of the gate line 32.

[0024] In the second embodiment, as shown in Fig. 2a, the data line 39 overlaps the gap 314 of the gate line pair 31 and a portion of the gate line pair 31. The pixel electrode 33 overlaps a portion of the second gate line 312. The pixel electrode 33 overlaps a portion of the first gate line 311.

[0025] Fig. 2b is a cross-sectional diagram along the line III-III' of Fig. 2a. On a substrate, such as a glass substrate, the first gate line pair 31, an insulation layer 35, a semiconductor layer 37, a data line 39, a passivation layer 41, a low dielectric constant layer 43 and a pixel electrode 33 are formed sequentially. Obviously, the portion that the data line 39 overlaps the first gate line 31 is different from the portion that the pixel electrode 33 overlaps the first gate line 31.

[0026] Fig. 2c is a cross-sectional diagram along the line IV-IV' of Fig. 2a. In the present invention, the gate line 32 and the insulation layer 35 are formed sequentially on the substrate 300. Thus, after the semiconductor layer 37 and the data line 39 are formed as illustrated in Fig. 2b, the passivation layer 41, the low dielectric constant layer 43 and the pixel electrode 33 are formed sequentially. As shown in Fig. 2c, the pixel electrode 33 overlaps a portion of the gate line 32.

[0027] In the present invention, the material of the insulation layer 35 includes a Si_3N_4 layer depositing above the data line pair 31, the gate line 32 and the substrate 300. The material of the semiconductor layer 37 includes an undoped Si amorphous layer and a doped Si amorphous layer. The material of passivation layer 41 includes Si_3N_4. The low dielectric constant layer 43 is a transparent material with low dielectric constant, such as the acrylic. The material of the pixel electrode 33 includes ITO (Indium Tin Oxide).

[0028] The structure of an LCD proposed in the present invention may effectively increase the aperture ratio and avoid the leakage of light. Moreover, it may reduce the disconnection caused by a signal line to reduce the capacity effect between a signal line and a pixel electrode.

[0029] In the foregoing specification, the invention has been described with reference to specific embodiments. However, various modifications and changes can be made without departing from the scope of the present invention as set forth in the claims. Accordingly, the specification and figures are to be regarded in an illustrative rather than a restrictive sense, and all such modifications are intended to be included within the scope of present invention as claimed.